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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/056,747	01/24/2002	Joakim O. Blanch	1391-26700	9923

23505 7590 08/21/2003

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EXAMINER
LE, TOAN M

ART UNIT	PAPER NUMBER
2863	

DATE MAILED: 08/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/056,747	BLANCH ET AL.	
	Examin r	Art Unit	
	Toan M Le	2863	

-- The MAILING DATE of this communication appears on the cov r sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 June 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claims 12-20 are hereby rejoined and fully examined for patentability under 37 CFR 1.104.

Since all claims previously withdrawn from consideration under 37 CFR 1.142 have been rejoined, the restriction requirement is hereby withdrawn.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-11 are rejected under 35 U.S.C. 102(a) as being anticipated by Kimball.

Referring to claim 1, Kimball discloses in a system for acoustic logging of an earth formation comprising a transmitter creating acoustic energy and a plurality of receivers recording time domain representations of the acoustic energy as it traverses the earth formation, a method of signal processing to determine acoustic velocity as a function of frequency comprising (col. 2, lines 24-27; col. 14, lines 12-18): converting the time domain representations of the acoustic energy into frequency domain representations (col. 2, lines 58-61); creating a correlation matrix from amplitudes within the frequency domain representations at corresponding frequencies; finding a plurality of component functions that define an orthogonal basis of the correlation matrix (col. 14, lines 22-29); removing at least one component function to create a subspace (col. 14, lines 30-31); and multiplying a test vector and the subspace, the test vector based on an

estimated acoustic velocity of the earth formation, to determine whether the estimated acoustic velocity substantially matches the actual earth formation acoustic velocity (col. 14, lines 32-33).

As to claim 2, Kimball discloses in a system for acoustic logging of an earth formation comprising a transmitter creating acoustic energy and a plurality of receivers recording time domain representations of the acoustic energy as it traverses the earth formation, a method of signal processing to determine acoustic velocity as a function of frequency comprising (col. 2, lines 24-27; col. 14, lines 12-18), wherein converting the time domain representations of the acoustic energy into frequency domain representations further comprises Fourier transforming each time domain representation to create each frequency domain representation (col. 7, lines 30-38; figure 5A, step 715).

Referring to claim 3, Kimball discloses in a system for acoustic logging of an earth formation comprising a transmitter creating acoustic energy and a plurality of receivers recording time domain representations of the acoustic energy as it traverses the earth formation, a method of signal processing to determine acoustic velocity as a function of frequency comprising (col. 2, lines 24-27; col. 14, lines 12-18), wherein finding a plurality of component functions further comprises determining eigenvectors and eigenvalues of the correlation matrix (col. 7, lines 53-57; col. 14, lines 25-27).

As to claims 4-7, Kimball discloses in a system for acoustic logging of an earth formation comprising a transmitter creating acoustic energy and a plurality of receivers recording time domain representations of the acoustic energy as it traverses the earth formation, a method of signal processing to determine acoustic velocity as a function of frequency comprising (col. 2, lines 24-27; col. 14, lines 12-18), wherein removing a component function to create a subspace

further comprises removing a higher order eigenvectors and a plurality of higher order eigenvectors corresponding to received acoustic energy related to the acoustic energy created by the transmitter, a lower order eigenvector and a plurality of lower order eigenvectors corresponding to received noise (col. 5, lines 48-67; col. 6, lines 60-67; col. 7, lines 1-13 and 29-67; col. 8, lines 1-4; col. 14, lines 30-31).

Referring to claims 8-9, Kimball discloses in a system for acoustic logging of an earth formation comprising a transmitter creating acoustic energy and a plurality of receivers recording time domain representations of the acoustic energy as it traverses the earth formation, a method of signal processing to determine acoustic velocity as a function of frequency comprising (col. 2, lines 24-27; col. 14, lines 12-18), wherein multiplying a test vector and the subspace to determine whether the estimated acoustic velocity substantially matches the actual earth formation acoustic velocity further comprises calculating an objective function using substantially the following equation: $1/|N_f W_f|^2$ where N_f is the subspace and $W_f = [\ 1\ e^{-jds}\ e^{-j2ds}\ e^{-j3ds}\ \ldots\ e^{-j(n-r)ds}\ ]$ is the test vector, where d is the distance between the receivers, s is the estimated acoustic velocity, n is the total number of received signals and r is the number of removed eigenvectors (equations 24 and 26; figure 5B).

As to claims 10-11, Kimball discloses in a system for acoustic logging of an earth formation comprising a transmitter creating acoustic energy and a plurality of receivers recording time domain representations of the acoustic energy as it traverses the earth formation, a method of signal processing to determine acoustic velocity as a function of frequency comprising (col. 2, lines 24-27; col. 14, lines 12-18) further comprising repeating the multiplying step for a plurality of test vectors comprising a plurality of estimated acoustic velocities and repeating the creating,

finding, removing, multiplying steps for a plurality of corresponding frequencies (col. 14, lines 35-38).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 12-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kimball.

As to claims 12-20, Kimball discloses a system incorporated into a method for acoustic logging of earth formations where a transmitter creates acoustic signals in the earth formation, a plurality of receivers detect the acoustic signals, and the acoustic signals are transformed into their frequency domain representations, a method of determining slowness of the earth formation as a function of frequency (col. 2, lines 24-27; col. 14, lines 12-18) comprising: calculating a correlation matrix from components of each of the frequency domain representations at a particular frequency (col. 14, lines 22-29); determining eigenvectors and corresponding eigenvalues of the correlation matrix (col. 7, lines 53-57; col. 14, lines 25-27); removing at least one eigenvector to create an incomplete basis (col. 14, lines 30-31), the removed at least one higher/lower order eigenvector/a plurality of higher order eigenvectors corresponding to acoustic signals and the remaining eigenvectors corresponding to noise (col. 5, lines 48-67; col. 6, lines 60-67; col. 7, lines 1-13 and 29-67; col. 8, lines 1-4; ; col. 14, lines 30-31); calculating a value of

an objective function indicative of the degree to which a test vector may be represented by the incomplete basis including calculating a value of an objective function indicative of the degree to which the test vector may be represented by the remaining eigenvectors corresponding to noise and the value of an objective function that approaches zero when the test vector may be substantially represented by the remaining eigenvector (col. 5, lines 48-67; col. 6, lines 60-67; col. 7, lines 1-13 and 29-67; col. 8, lines 1-4; col. 14, lines 30-31) using substantially the following equation: $1/|N_f W_f|^2$ where N_f is the subspace and $W_f = [\ 1\ e^{-jds}\ e^{-j2ds}\ e^{-j3ds}\ \ldots\ e^{-j(n-r)ds}\ ]$ is the test vector, the test vector based on an estimated slowness of the earth formation (col. 14, lines 32-33); plotting the value of the objective function as a function of the estimated slowness of the test vector and the particular frequency of the components in the time series representations used to calculated the correlation matrix (figures 11-12).

Kimball does not show plotting the value of the objective function as a function of the estimated slowness of the test vector and the particular frequency of the components of the frequency domain representations used to calculate the correlation matrix.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have plotted the value of the objective function as a function of the estimated slowness of the test vector and the particular frequency of the components of the frequency domain representations and/or time series for a comparison between time series domain and frequency domain to improve an estimation of acoustic velocity and frequency dispersion of an earth formation.

Referring to claims 21-28, Kimball discloses a method of determining acoustic velocity and frequency dispersion of an earth formation using an acoustic tool including an acoustic

transmitter with four acoustic receivers (figure 2), the method comprising: a) sending acoustic energy into the earth formation from the acoustic tool; b) detecting the acoustic energy in the earth formation at a plurality of receiver locations on the acoustic tool (col. 14, lines 12-18); c) creating time series representations of the acoustic energy in the earth formation for each of the plurality of receiver locations (col. 2, lines 58-61); d) Fourier transforming each of the time series representations to create a plurality of frequency domain representations (col. 7, lines 30-38; figure 5A, step 715); e) creating a vector from values at a selected frequency in each of the plurality of frequency domain representations; f) creating a correlation matrix from the vector (col. 14, lines 22-29); g) determining the eigenvectors and eigenvalues of the correlation matrix (col. 7, lines 53-57; col. 14, lines 25-27); h) removing at least one of the eigenvectors thereby creating a subspace (col. 14, lines 30-31); i) determining a value that is indicative of the extent a test may be represented by the subspace, and wherein the test vector is based on an estimated acoustic velocity of the earth formation (col. 14, lines 32-33); j) plotting the value as a function of the estimated acoustic velocity of the earth formation and the selected time series (figures 11-12); k) repeating steps i) and j) for a plurality of estimated acoustic velocities; and l) repeating step e) through k) for a plurality of selected frequencies (col. 14, lines 34-37), wherein step a) further comprises sending acoustic energy into the earth formation at a depth level of interest and repeating steps a) through l) for a plurality of depth level of interest (col. 10, lines 1-7), wherein step h) further comprises removing at least one higher order eigenvector corresponding to desired acoustic signals and the remaining eigenvectors corresponding to noise (col. 14, lines 30-31), wherein step i) further comprises applying a test vector to the subspace with the result of the applying being the value indicative of the extent the test vector may be represented by remaining

eigenvectors corresponding to noise following the equation: $1/|N_f W_f|^2$ where N_f is the subspace and $W_f = [\ 1\ e^{-jds}\ e^{-j2ds}\ e^{-j3ds}\ \ldots\ e^{-j(n-r)ds}\ ]$ is the test vector, where d is the distance between the receivers, s is the estimated acoustic velocity, n is the total number of received signals and r is the number of removed eigenvectors (col. 14, lines 32-33; equations 24 and 26; figures 5B).

Kimball does not show plotting the value as a function of the estimated acoustic velocity of the earth formation and the selected frequency.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have plotted the value as a function of the estimated acoustic velocity of the earth formation with either the selected frequency or time series for a comparison between time series domain and frequency domain to improve an estimation of acoustic velocity and frequency dispersion of an earth formation.

Remarks:

Response to Arguments

Applicant's arguments filed 6/4/03 have been fully considered but they are not persuasive.

Referring to claims 1, 4, 21, and 25, Applicant argues that "Kimball may define a plurality of model orthonormal basis U^k for each wave type expected to exist in a particular system (compressional, shear, Stoneley)- **model space** while claim 1 is directed to the **data space**. Kimball and claim 1 operate in totally different spaces".

Kimball does teach a method for **acoustic logging** to determine acoustic velocity/slowness as a function of frequency operates in the data space comprising compressional, shear, flexural, and Stoneley wave slowness (col. 2, lines 24-65).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Toan M Le whose telephone number is (703) 305-4016. The examiner can normally be reached on Monday through Friday from 9:00 A.M. to 5:30 P.M..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Barlow can be reached on (703) 308-3126. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-0655.

Toan Le

August 8, 2003

John Barlow
Supervisory Patent Examiner
Technology Center 2800